D.C. Amplifier

9790

Guildline INSTRUMENTS LTD.

SMITHS FALLS, ONTARIO

$ 1598

TYPE 9790 D.C. AMPLIFIER

THE PRE-AMPLIFIER CHASSIS IS SUPPORTED DURING TRANSPORTATION BY A SMALL WOODEN BLOCK. THIS BLOCK MUST BE REMOVED BEFORE PUTTING THE AMPLIFIER INTO SERVICE.

TO DO THIS REMOVE THE FOUR FRONT PANEL FIXING SCREWS AND WITHDRAW THE CHASSIS FROM THE CASE. THE CHOPPER AND PRE-AMPLIFIER SECTIONS ARE ENCLOSED BY A MAGNETIC SHIELD WHICH IS PAINTED BLACK AND IS HELD IN POSITION BY FIVE 4-40 NUTS AND BOLTS. REMOVE THESE FIVE NUTS AND BOLTS AND LIFT OFF THE MAGNETIC SHIELD. THE PRE-AMPLIFIER CHASSIS CONTAINING THE SIE TRANSFORMER AND ONE 12AU6 TUBE WILL BE SEEN TO BE SUPPORTED FROM BELOW BY A SMALL WOODEN BLOCK. (No blocks) CAREFULLY SLIDE THE BLOCK OUT TO ALLOW THE PRE-AMPLIFIER CHASSIS TO REST ON ITS SHOCK MOUNTS.

REPLACE THE BLACK MAGNETIC SHIELD WITH THE FIVE 4-40 NUTS AND BOLTS AND REPLACE THE AMPLIFIER CHASSIS IN THE CASE.

TO AVOID DAMAGE TO THE WIRING OF THE PRE-AMPLIFIER CHASSIS THE WOODEN BLOCK OR ITS EQUIVALENT SHOULD BE REPLACED IF THE AMPLIFIER IS RE-SHIPPED.

GUILDLINE INSTRUMENTS LIMITED

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D.C. MICROVOLT AMPLIFIER

TYPE 9790

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Guildline Instruments Ltd.
Smiths Falls, Ontario, Canada,
November 1965.

D. C. MICROVOLT AMPLIFIER

TYPE 9790

1. GENERAL

1.1) Purpose

The Type 9790 Microvolt Amplifier is designed for the amplification of small d.c. voltages to a level suitable for the operation of a milliameter, strip chart recorder or a potentiometric recorder. By means of the built-in test voltage circuit the amplifier and indicator can be calibrated to an accuracy equal to the accuracy of the test voltages.

1.2) Range

At maximum gain the amplifier will supply a current of 1mA into a 1500 ohm detector from an input signal of 0.03 microvolt originating in a source with resistance equal to the input resistance of the amplifier.

1.3) Power Requirements

The amplifier may be supplied for operation from 110 volt 60c/s line or 230 volt 50c/s supply as required. In both cases the power requirement is 70 watts.

2. CONTROLS AND TERMINALS

2.1) Input Terminals

The input terminals are enclosed by a cylindrical cover which serves as an electrostatic, magnetic and thermal shield. The lower terminal is internally connected to the amplifier chassis and may be connected externally to ground. The upper two terminals are connected directly to the chopper input contacts.

2.2) Thermal Compensator ("BALANCE" controls, coarse and fine)

The thermal compensator may be used to neutralize any steady emf which may exist in the input circuit and which is with the ranges (1 to 4) of the

compensator. It may also be used for zero suppression or, in applications where a change of polarity of the observed signal is to be observed, as a zero boost. As may be seen from the circuit diagram the thermal compensator bridge network is formed by two 0.07 ohm resistors and the two parts of a 5000 ohm variable resistor. When the variable resistor is in the mid-position equal and opposite currents flow in the two 0.07 ohm resistors and the resultant emf applied to the amplifier input is zero. On range 1 the internal 1.35V battery is applied to the bridge through a 330,000 ohm resistor and the resulting range of compensation is ±0.3uV. Ranges 2, 3 and 4 give respectively 3, 30 and 300uV. The continuously variable fine control has a two section concentric vernier dial action to provide good resolution. The Thermal Compensator operates only when an external circuit is connected to the input terminals.

2.3) Calibration signals ("TEST uV")

One of the two 0.07 ohm resistors of the Thermal Compensator circuit is additionally used for the injection of calibration signals. As in the case of the thermal compensation voltages the calibration signals can be applied only in series with a circuit connected across the input terminals. Signal magnitudes, as engraved on the dial are 0.03, 0.1, 0.3, 1, 3, 10, 30, 100 and 300uV and are accurate to ±10%.

2.4) Gain Controls ("COARSE" and "FINE")

The gain controls, centrally located on the amplifier panel consist of a 20 position switch and a continuously variable dial. Each increasing switch step gives approximately 100% increase in amplifier gain.

2.5) Output Selector ("RECORDER")

The amplifier output can be switched to give 1mA into a 1500 ohm pointer instrument or recorder or may be switched into one of three internal voltage dividers

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to give outputs of approximately 100, 10 or 1mV. The latter three alternatives are suitable for the operation of self balancing potentiometric recorders.

2.6) Output filters

Five alternative values of capacitance and resistance can be selected on the Output Filter switch. These filters may be used to eliminate short term noise originating in the tested circuit. Increasing filtering results in a corresponding increase in response time, the maximum (5) giving a response time of approximately 6 seconds to 90% of full scale and the minimum a response time of approximately 1 second to full scale.

2.7) Output connections

The output from the amplifier is taken from a 2 pin socket at the rear of the instrument.

2.8) Fuses, pilot light and ON/OFF switch

Two 2 amp fuses are mounted adjacent to the ON/ON/OFF switch. One is in the primary circuit of the line transformer and the other is in the chopper motor circuit. The pilot light is connected across the primary of the line transformer and is extinguished if the associated fuse is blown. The ON/ON/OFF switch has a down OFF position. In the up position the amplifier circuit and chopper motor are both energized. In the centre position the chopper is stopped, but the amplifier remains energized. This switch position may be used when it is required to stop the chopper but to hold the amplifier at operating temperature.

3. OPERATION

3.1) Mounting

The amplifier may be operated as a bench instrument in the steel case supplied or may be removed from the case and mounted in a standard 19" rack.

3.2) Stability

Switch on the amplifier and chopper motor and allow a short time for warm-up. If the amplifier is being used at low gain (eg. 30uV full scale) it may be used almost immediately and there is no need to wait for thermal equilibrium to be attained. If the amplifier is being used at maximum, or near maximum gain (0.03uV full scale) it may be expected that zero drift will take place due to thermal emfs in the input circuit until thermal equilibrium has been attained. This may take several hours but when thermal equilibrium has been achieved a zero drift of not more than 0.003 microvolt (3×10^{-9} volt) in a 24 hour period should be expected.

It is recommended that this condition be checked within the amplifier as follows before using it on a test circuit. Remove the cover from the input terminals and short circuit them with a clean piece of bare copper wire. Make sure that the terminals are clean. Connect the ground terminal to a good ground. Pack the terminals carefully with the foam rubber thermal insulation and replace the cover taking care to tighten down the holding screw securely. Connect the output to a 1mA full scale chart recorder and with the gain set to position 18 or 19 inject a calibration signal of 0.03uV. Adjust the gain to give a deflection of approximately 90% of full scale. Set the chart speed to about 1" per hour and observe zero and gain stability as the amplifier warms up.

3.3) External Circuit

When connecting an external circuit for the observation of fractional microvolt signals it is important that good thermal techniques be used or the results will be completely masked by spurious signals.

Joints in external wiring should be avoided. It is possible to generate 0.05 microvolt per C degree temperature difference at the junction of different grades of copper. Where joints must be made they should be clean and should

be made in each wire of the pair of leads or at the same point so that thermal equality between the two junctions can be maintained. The leads from the amplifier input terminals to the tested circuit should be tightly twisted to avoid loops which would be susceptible to magnetic coupling. The leads should also be shielded to eliminate electrostatic pickup and should not be allowed to swing between tie-down points since this can result in the generation of periodic voltages as the conductors cut the earth's magnetic field.

3.4) Input Impedance

The effective input impedance of the amplifier is approximately 50 ohms. This impedance is dependent on chopper speed and on the value of the capacitor C1 connected across the secondary of the input transformer. It may be checked by noting the value of resistance across the input terminals which is required to reduce the output to half.

4) MAINTENANCE

4.1) Chopper contacts

Dirt on the chopper contacts gives rise to erratic operation and a high noise level. To clean the contacts remove the magnetic shield from the chopper section at the left hand end of the chassis and remove the cover from the chopper. With a small stiff bristle brush or a clean piece of chamois leather rub the contacts thoroughly to remove all foreign matter. The use of solvents or cleaning fluids is not recommended since these almost invariably leave a film deposit.

4.2) Chopper make/break ratio

It is usual to check the make/break ratio of the chopper contacts at the same time as they are cleaned. The dome contacts tend to flatten with use and the

ratio consequently changes. Disconnect the input and output leads and the cross connections. With the chopper running, connect a multi-meter which has both an ohms scale and a 0-100 volt scale between a center (moving) contact and an outer (fixed) contact. Switch the meter to the ohms scale. The meter will deflect by an amount proportional to the fraction of the cycle during which the contacts are made and this fraction may be read directly from the 100 volt scale as a percentage. Adjust the make time to 51% of the cycle for all four contacts on the input section of the chopper by means of the small knurled screws. Since these contacts are operating make before break the make period may be checked by connecting the meter across the two outer contacts. The meter should indicate about 2% make.

Similarly adjust the output chopper section to have approximately 48% make. Reconnect the cross connecting leads and the input and output leads.

4.3) Phase adjustment

Phase adjustment is not critical and there is no reason why the orginal factory adjustment should be lost. Phase of the input and output chopper sections may be adjusted by rotating the cams on the drive shaft. The cam may be disengaged from the shaft by loosening the single slotted screw.

The amplifier should be adjusted to give a 50% full scale deflection for an input of say, 30uV with the input terminals short circuited. Having obtained a steady deflection, stop the chopper, loosen a cam socket screw and rotate the the cam a few degrees. Restart the chopper and observe the new gain. Repeat this procedure to obtain maximum gain. Optimum performance is obtained at approximately 180° relative phase between input and output chopper sections.

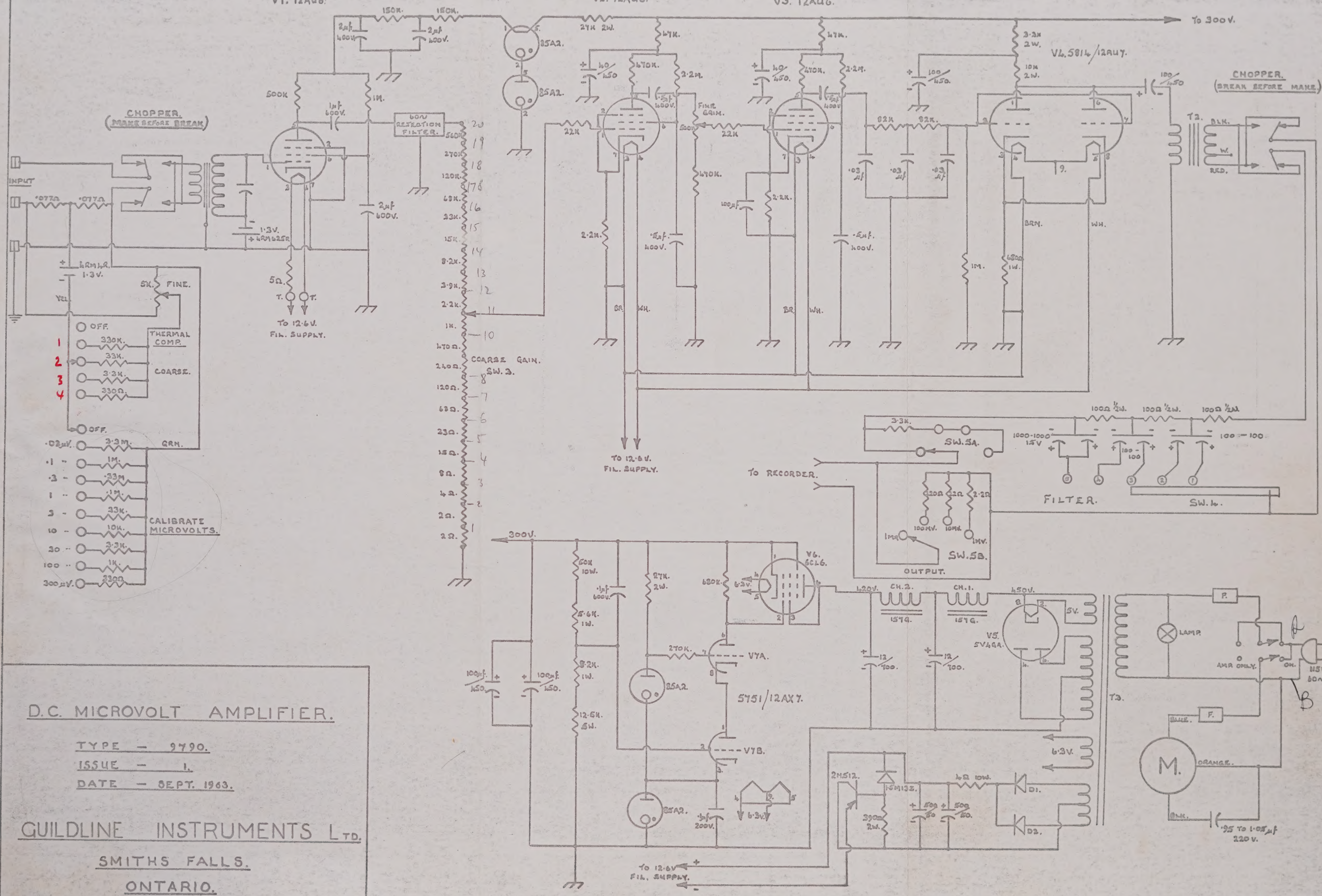
4.4) Noise

Noise in the amplifier may arise from a variety of causes. Dirty chopper

contacts have already been mentioned; additionally, noise may be generated by dirty input terminals or by noisy tubes. If noise is excessive (eg. greater than 0.003 microvolt) with the input terminals short circuited and if the chopper contacts have been cleaned and adjusted the tubes should be replaced one by one commencing with the pre-amplifier tube.

4.5) Mercury cells

Two mercury cells are used and both are located beneath the magnetic shield on the pre-amplifier and chopper section. One Type 4RM4R cell supplies the thermal compensator and calibrate circuits and the other, Type 4RM625R provides bias for the pre-amplifier stage. In both cases life may be expected to approximate shelf life and replacement should not be necessary more frequently than at yearly intervals.



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